Economic Costs of Salinity in the Central Valley

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Salinity Study Criteria

- Measure the Economic Effects of Salinity in the Central Valley
- Time horizon- 2004-2030
- No changes in current policy
- No effects from Nitrates or Selenium
- Use existing aggregate hydrogeology
- First time such a study has been done

Types of Economic Impact

- Direct effects
  - Cost increase
  - Loss of output
  - Cost or production functions
- Indirect Effects
  - Secondary Income effects, regional & statewide
  - Linked employment changes
- Non-Market Effects
  - Changed quality of environment
  - Changes in water quality
  - Changes in recreation experience

Economic Sectors

- Industrial
- Residential
- Crop Processing
- Animal Processing
- Irrigated crop production
- Confined animal production

Methods and Models

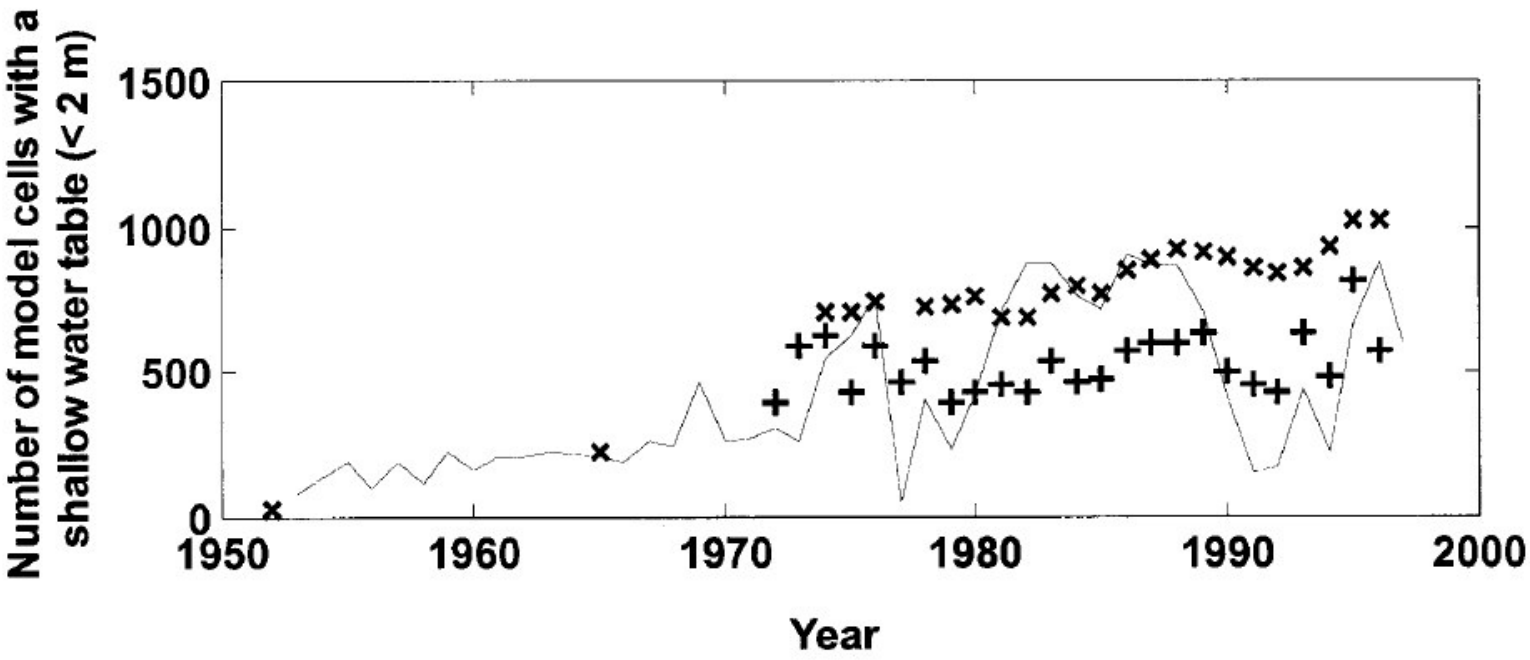
- Net salinity accumulation
  - Shoups, Shoups & Hopmans, Orlob, Rainbow Report
- Industry, Residential, & Processing
  - Hilmar study
- Irrigated Agriculture
  - Swap model, DWR crop data, DWR Salinity data, County Ag Commissioners reports
- CAFO
  - Kaplan CAFO model

Salinity Projections 2004- 2030

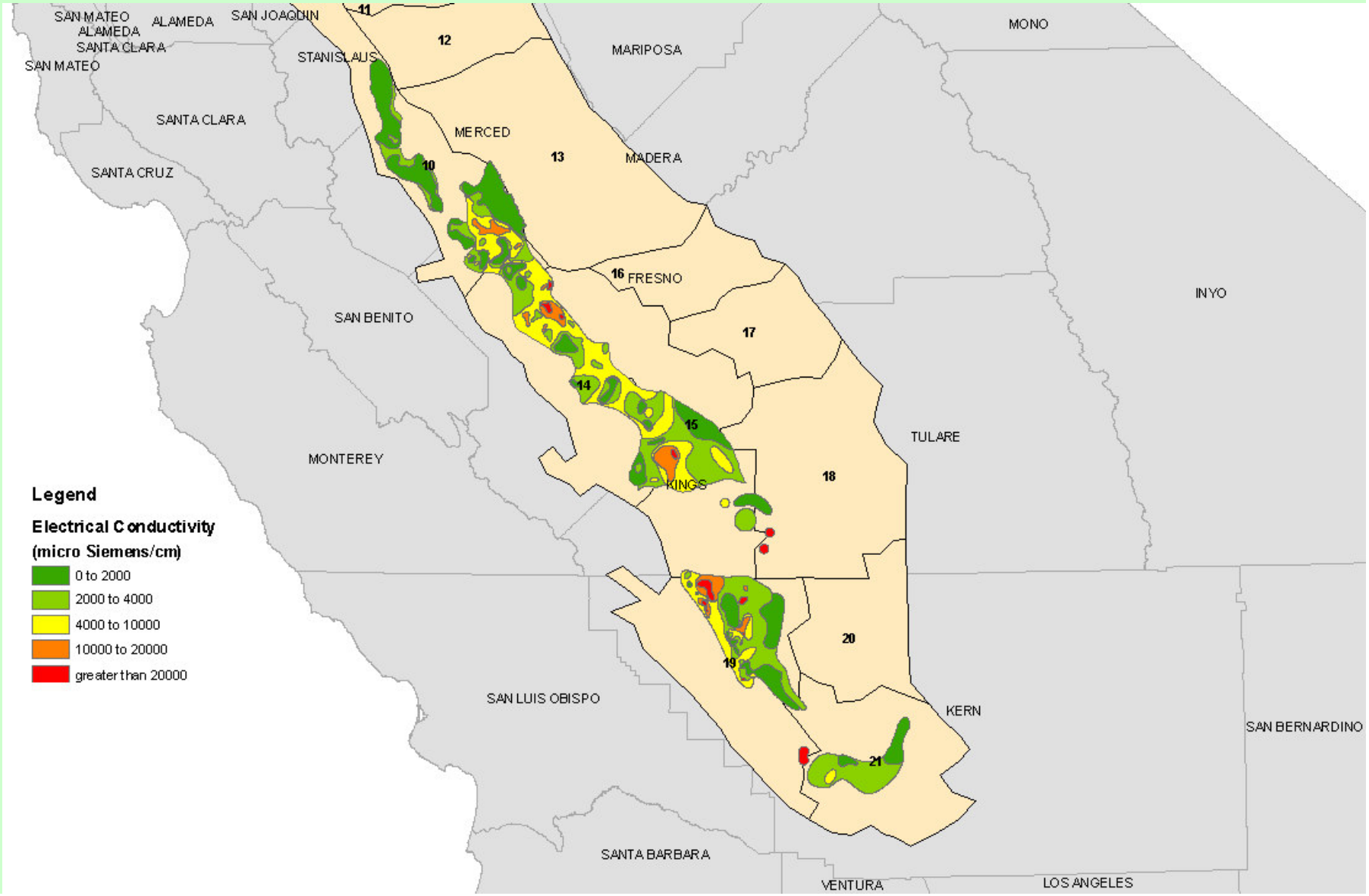
- Sources--- Shoups & Hopmans 2005, Shoups(2004), Orlob(1991), San Joaquin Valley Drainage report(1990) “Rainbow Report”.
- Average annual net salt increase 499,000 tons
- Change in salt affected area- Shoups (2004)
  0.5% / year- Increase of 240,000 acres (13%) by 2030
- Salinity levels and areas- DWR SJ Valley Drainage Monitoring Program 2001- Plate 1.
- 5 salt levels in shallow saline water. Current salt affected area 1.85 million acres
- Deep aquifer salinity accumulation Shoups & Hopmans 2005- 24% percolation– net average aquifer salinity change 2004- 2030— 264mg/L – 282 mg/L.

Relative change in the shallow groundwater table

(0.46 - 0.58% /pa-- Shoups 2004).



Saline Affected Areas (DWR 2001)



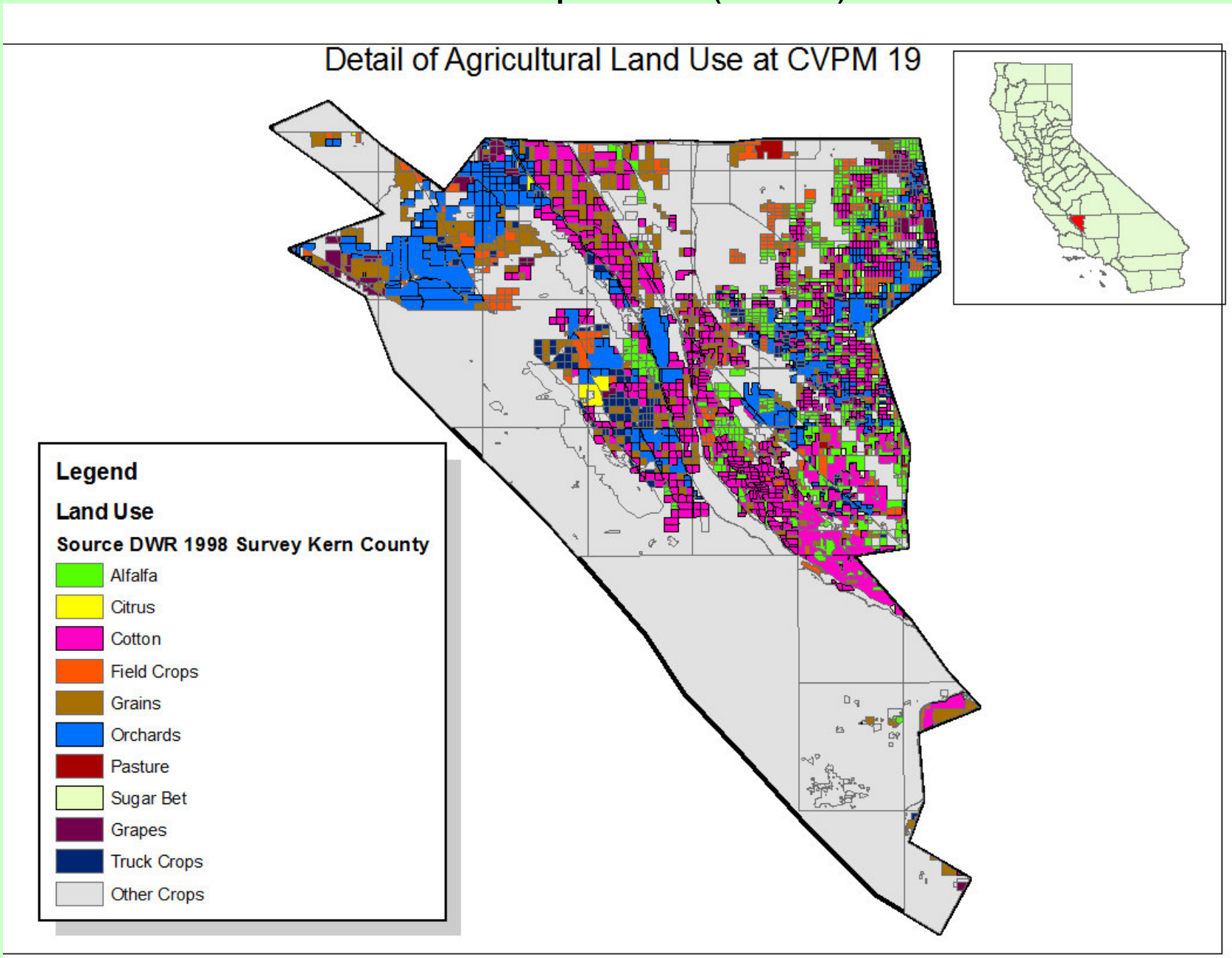
Direct Salinity Costs

- Residential/Urban salinity cost function- “Salinity Management Report” MWD, Bookman-Edmonston (1999) and Hilmar report.
- Industrial salinity cost function- Wilson (2000) Process treatment, boiler operation, cooling tower.
- Food processing.
  - Compliance costs- Hilmar study extended
  - Processor exit measured by the Residual demand method with updated elasticities

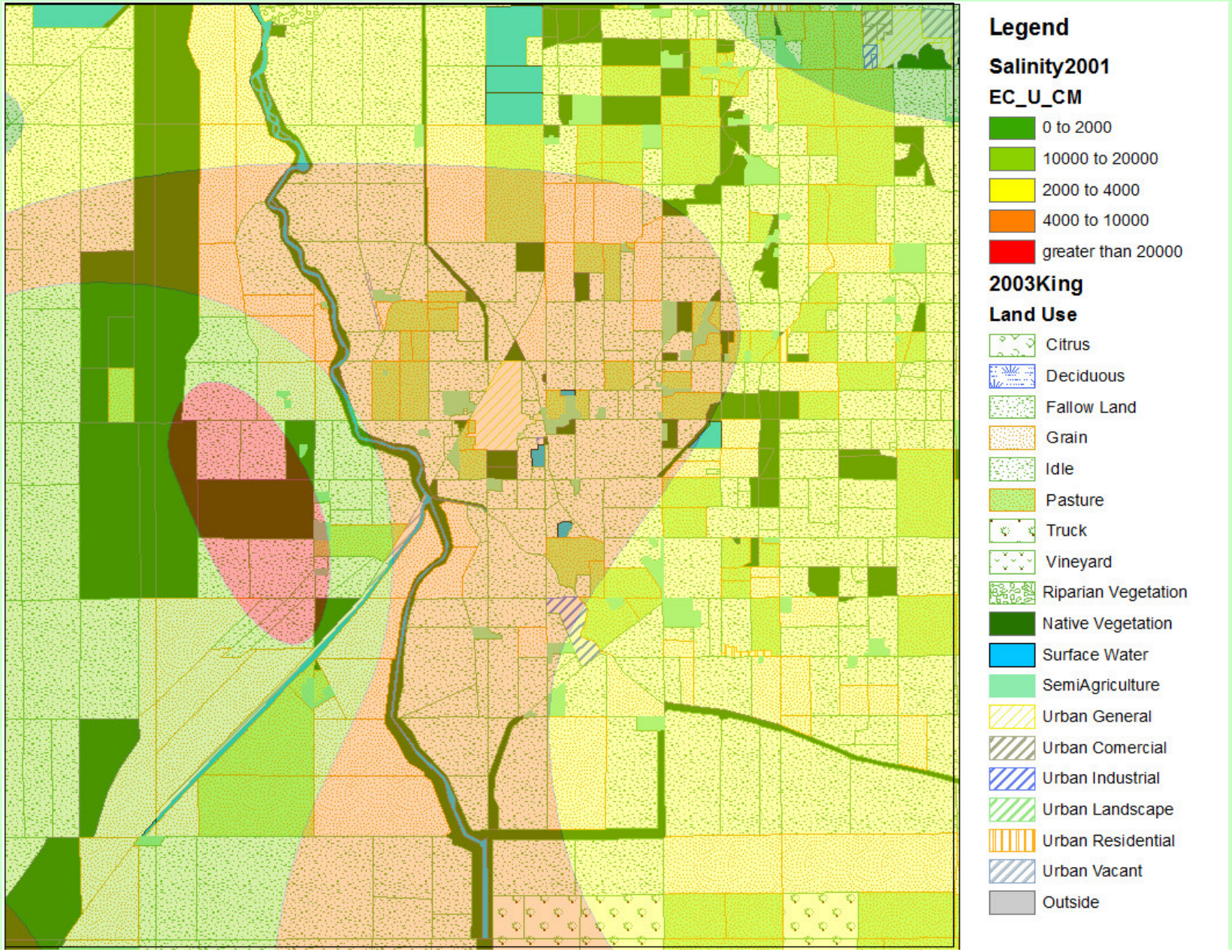
Salinity costs on Crop Production

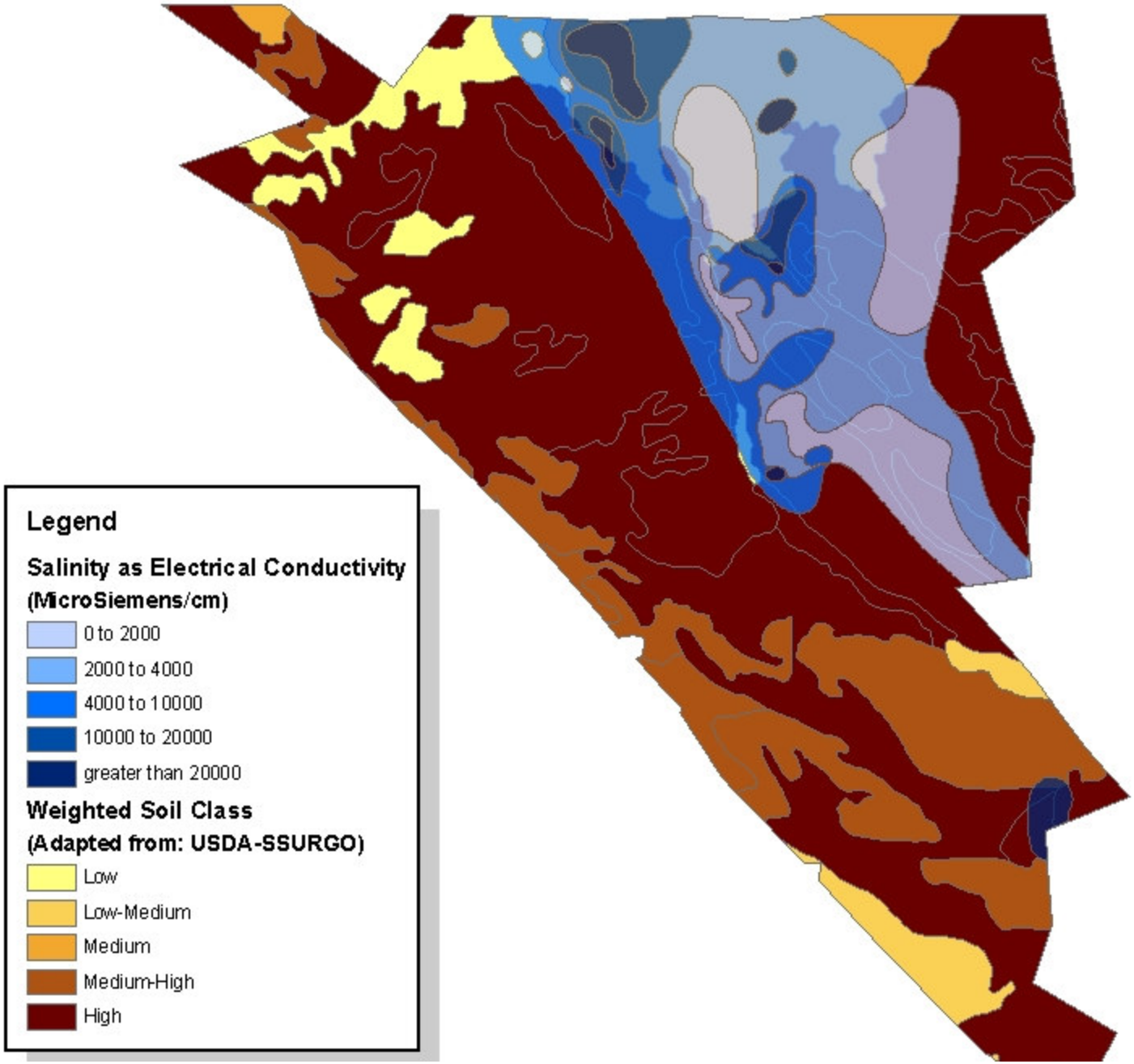
- Basis- Effect of salinity on actual farmer crop choice- DWR field level crop data.
- Statistical analysis of crop choice and effect on relative crop profitability.
- Projections to 2030
  - Loss of irrigated land to urbanization (Landis 2002)
  - Change in crop demands- (Tanaka et al 2006)
  - Change in crop yields- (Tanaka et al 2006)

Field Level Crop Data (DWR)



Interaction of Salinity and cropping




Legend
Salinity as Electrical Conductivity
(MicroSiemens/cm)
0 to 2000
2000 to 4000
4000 to 10000
10000 to 20000
greater than 20000
Weighted Soil Class
(Adapted from: USDA-SSURGO)
Low
Low-Medium
Medium
Medium-High
High

Salinity impacts on confined animal operations

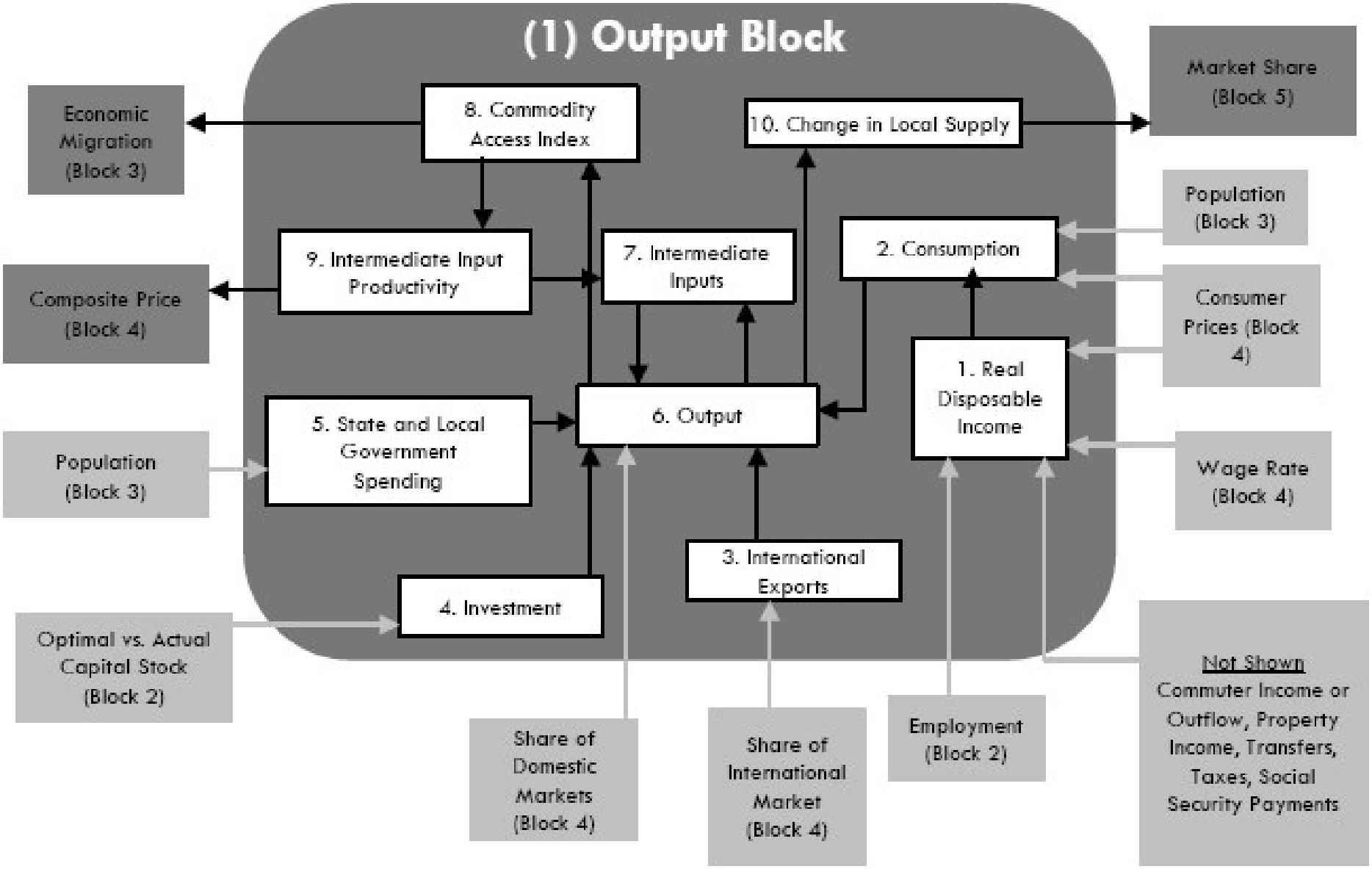
- Approach based on Kaplan et al (2004)- economic model of CAFOs
- Rate limiting variable is manure disposal by land application.
- Production & cost data from CDFA, USDA, UCD Coop extension, Western beef development center.
- Nitrogen and Phosphorus determine application
- Acceptance and compliance rates for field crops grown with economical distance from CAFOs determines the production level
- Projections based on 30% acceptance and 20% compliance.

Baseline Annual Animal Numbers by Basin

Basin	Dairy	Hog	Cattle	Broiler	Layer
Sacramento River	36,014	6,270	51,228	130,690	21,347
San Joaquin River	623,896	5,138	67,246	4,156,572	8,618,585
Tulare	843,750	8,290	49,005	14,005,610	13,257
Total	1,503,660	19,698	167,479	18,292,871	8,653,189

Indirect Economic Impacts

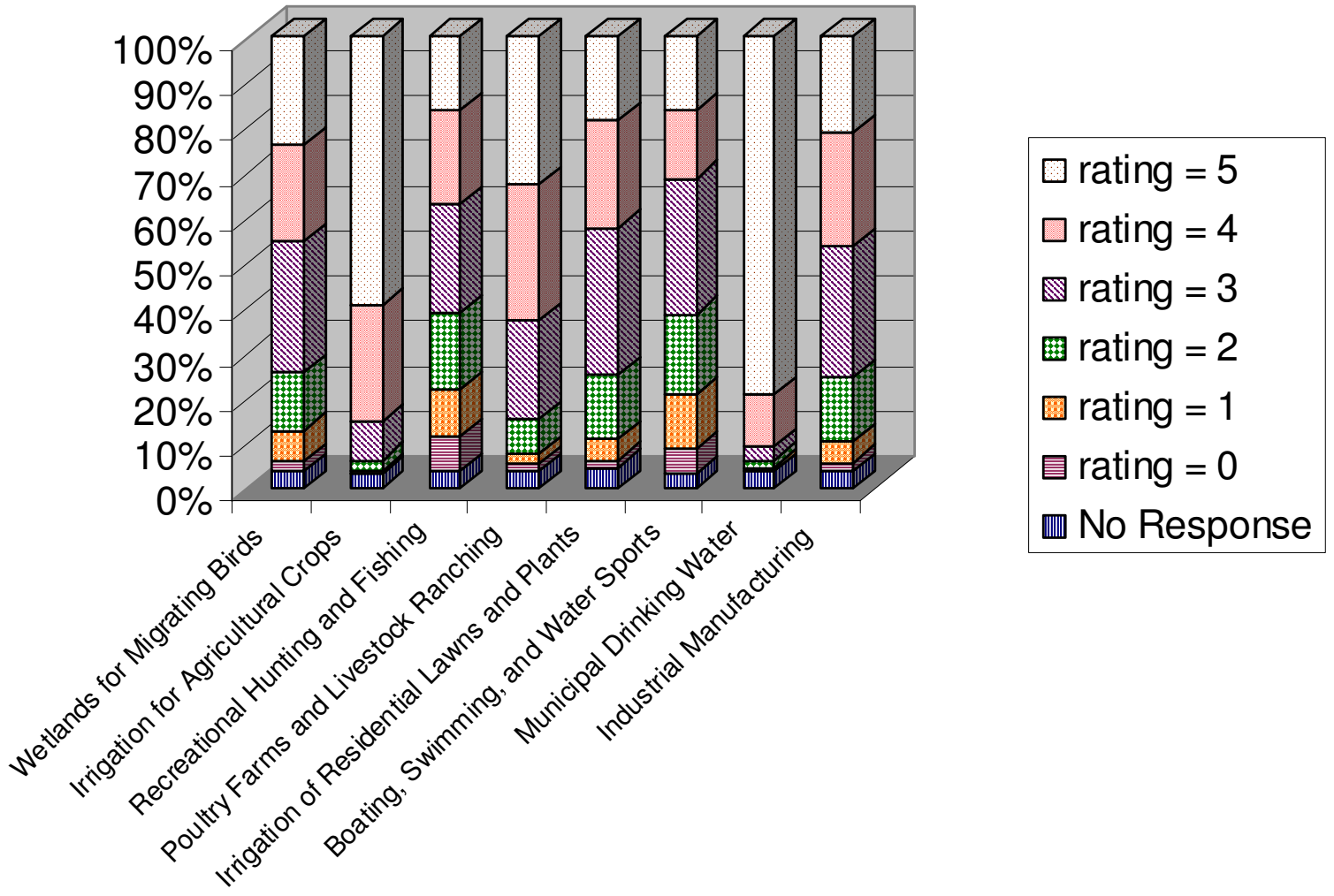
- REMI model- combined input/output and econometric forecasting model (REMI 2007)
- Linked regional and statewide model
- Department of Commerce data base
- Estimates the effect on regional and statewide income of regional output changes.
- Estimates the employment effect by region and state of output changes.


(1) Output Block
Economic Migration (Block 3)
8. Commodity Access Index
10. Change in Local Supply
Market Share (Block 5)
Population (Block 3)
9. Intermediate Input Productivity
7. Intermediate Inputs
2. Consumption
Composite Price (Block 4)
Consumer Prices (Block 4)
1. Real Disposable Income
5. State and Local Government Spending
6. Output
Population (Block 3)
Wage Rate (Block 4)
3. International Exports
4. Investment
Optimal vs. Actual Capital Stock (Block 2)
Not Shown
Commuter Income or Outflow, Property Income, Transfers, Taxes, Social Security Payments
Share of Domestic Markets (Block 4)
Share of International Market (Block 4)
Employment (Block 2)

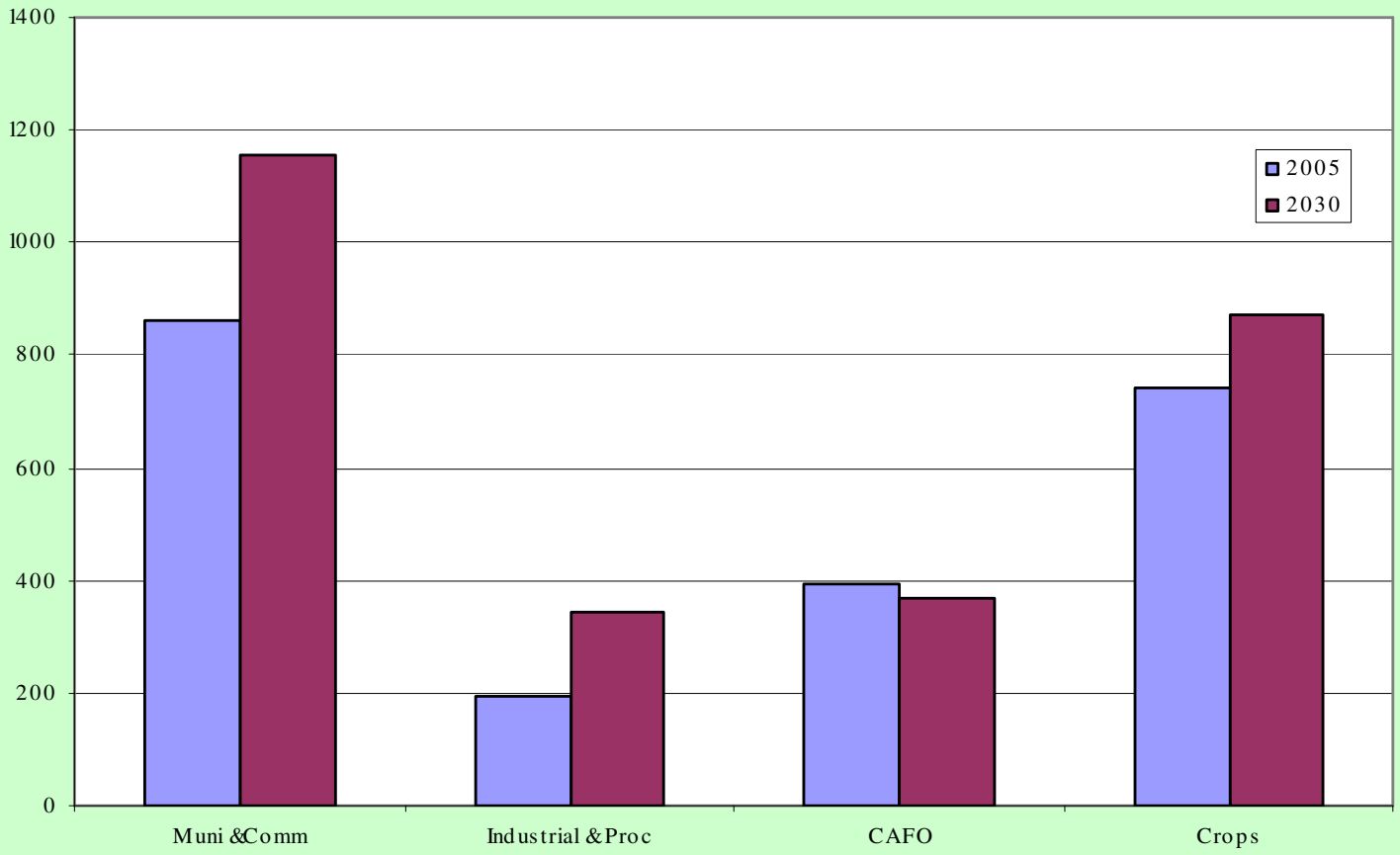
Non-Market Costs

- First time study, health, recreation, household costs, willingness to pay for reduced salinity.
- Household survey stratified by 3 geographic areas and 2 rural/urban divisions.
- 882 surveys sent, 389 (44%) responded.
- Average willingness to pay for salinity management $4.75/ month / household

Ratings of the Importance of Uses of Water

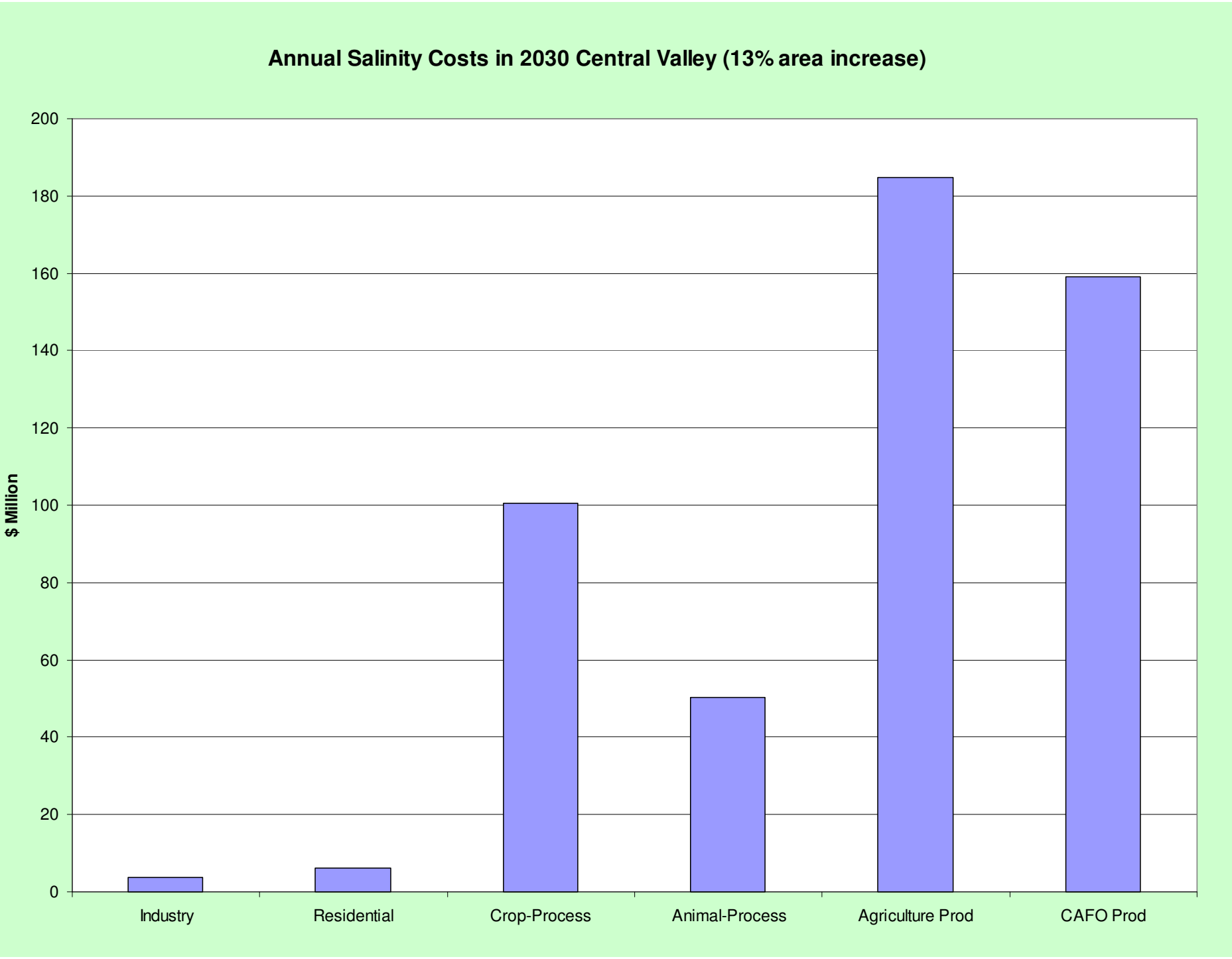


Salt Loads Central Valley (1000 tons/pa)



Annual Salinity Costs Central Valley 2030

Direct Costs	$Million pa	$Million pa
Industry	3.87	
Residential	6.2	
Crop-Process	100.6	
Animal-Process	50.4	
Agriculture Prod	184.7	
CAFO Prod	159.05	
Total Direct Cost		504.8
Indirect Costs		
Valley Income	682	
State Income	211	
Total Indirect Income Loss		893
Employment		
Valley Jobs	25,082	
Statewide Jobs	4,188	
Total Job Loss		29,270
Non-Market costs (2008)		145


Annual Salinity Costs in 2030 Central Valley (13% area increase)
$ Million
200
180
160
140
120
100
80
60
40
20
0
Industry
Residential
Crop-Process
Animal-Process
Agriculture Prod
CAFO Prod

Conclusions and Extensions

- Under current projections annual valley salinity costs will grow to close to 1 billion $ in statewide income loss and 30,000 jobs.
- Most of the cost will be born by crop and animal production sectors.
- The present study averages salinity and economic effects. Regional salinity and economic effects probably differ widely. More regional detail is needed
- More detailed cost functions are needed.
- The relationship between deep aquifer salinization and shallow perched groundwater needs investigation
- The effect of alternative delta facilities on the valley salt balance could be very significant.